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ABSTRACT

Computer-assisted learning (CAL) can be used for adults functioning at any academic or grade level. In adult basic education (ABE), CAL can promote greater learning effectiveness and faster progress, concurrent learning and experience with computer literacy skills, privacy, and motivation. Adults who face barriers (financial, geographic, personal, or motivational) affecting their attendance or progress and adults who prefer self-paced learning should be considered for CAL. For a CAL system to be successful, it should have features that make it relevant to adults, reliable, and effective. Competency-based learning principles, emphasizing careful determination of previous learning, the mastery of new concepts and skills, and retention through review, are recommended for courseware design. The use of competency-based learning principles implies a new role for the instructor as facilitator, motivator, and guide, rather than as dispenser of information. The focus on individual needs results in a more flexible environment, where problems with scheduling, interpersonal conflicts, and other barriers to the learning process are minimized. (Essential features of courseware, software, hardware, and vendor support for a CAL system are suggested, and a checklist is provided to assist adult educators to identify questions to be posed to vendors. There are 21 references.) (KC)

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ADULT LITERACY LEARNING AND COMPUTER TECHNOLOGY: FEATURES OF EFFECTIVE COMPUTER-ASSISTED LEARNING SYSTEMS

November, 1991

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Presented at the Alberta Association for Adult Literacy annual conference, Lethbridge, November 22, 1991.

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PLATO Education Services

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EXECUTIVE SUMMARY

In this paper, evidence is presented for the efficacy and efficiency of computer-assisted learning (CAL) for adults functioning at any academic grade level. Reasons offered for using CAL in adult basic education (ABE) include:

-- greater learning effectiveness, faster progress;
-- concurrent learning and experience with computer literacy skills;
-- privacy;
-- motivation.

Traditional ABE uses of CAL have not usually changed the students' experiences, but have eased materials preparation and record-keeping tasks for instructors. With declining costs and increases in power of hardware, however, it is now feasible to provide cost-effective CAL for more adults.

The choice of candidates for CAL among typical ABE students should consider their needs. When adults face barriers (financial, geographic, personal, motivational) affecting their attendance or progress, or when they express a preference for self-paced learning, they should be considered for CAL. (It is

assumed that experienced adult educators can detect the initial signs of these problems quickly in their learners.)

For a CAL system to be successful, it should have features which make it adult, reliable, and effective. Competency-based learning principles, emphasizing careful determination of previous learning, the mastery of new concepts and skills, and retention through review, are recommended for courseware design. The use of competency-based (or mastery) learning principles implies a new role for the instructor, as guide, facilitator and motivator, rather than as dispenser of information. The focus on individual needs results in a more flexible environment, where problems with scheduling, interpersonal conflicts, and other non-essentials (barriers) of the learning process are minimized.

The paper concludes by suggesting features of courseware, software, hardware and vendor support which should be present in a well designed, adult CAL system. A checklist is provided to assist the adult educator or program administrator to identify questions which should be posed to vendors.

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Background

Evidence has been available for some time indicating that computer-assisted learning (CAL) can be applicable with and helpful to adult literacy and adult basic education (ABE) learners (Turner, 1988). One study which compared results of CAL experiments with adults, adolescents and children found significant effects for CAL at all functioning levels, adding, "This review found larger effects at college and adult levels than at elementary and secondary levels" (Roblyer, 1990, p. 54). More recently (1991), a Canadian Council on Social Development monograph concluded that computer-assisted learning:

-- can be four times as effective as traditional remedial instruction;

-- prepares participants to use computers on the job;

-- can help people deal with serious problems in private;

-- gives people an incentive to learn. (p. 10)

Presented at the Alberta Association for Adult Literacy annual conference, Lethbridge, November 22, 1991.

Decision-makers who are aware of the increasing evidence of the efficacy of CAL for adult literacy and upgrading programs face difficult choices about which system will best meet their students' needs. McCallister et.al. (1988) noted some time ago that this difficult decision must be made with "virtually no data." Today, based on experience and evaluation results, there may be both more data and a growing consensus among users as to what features comprise a flexible and effective CAL system for adults.

Driving the decision: students' needs

Historically, computer use in adult education has been constrained by the capabilities and costs of the technology. Turner (1988, p. 9) describes four stages of computer use:

1. Management of records, mailing lists, tutor-student data, other databases.

2. Instructional support -- readability formulas, word processing of tests and materials; computer-generated games, puzzles, drills and tests, often paper-based.

3. Supplemental instruction, usually using commercial products but occasionally locally authored; direct student use of the computer for drill and practice.

4. Primary means of instruction; "in many ways the most interesting," but "limited to literacy and ABE programs that [have] the funds to purchase the technology and design the software."

As the costs have declined and the capabilities of the technology have dramatically risen, more applications with a wider range of learners are now feasible. In adult education this is especially good news: we have been urged for years to be

sensitive to individual needs (Dickinson, 1973; Kidd, 1973; Berte, 1975; Bloom, 1976; Knowles, 1978; Cross, 1981; Zemke and Zemke, 1981), but have often not been able to manage the recordkeeping and materials preparation entailed by individualization. The challenge, now that the technology is at hand, is to focus on the needs of learners which the technology can address.

What are some of these needs? For adults, more important than the literacy level at which the student is functioning is the fact that adults as adults have common needs and preferences in their learning (Zemke and Zemke, 1981). Several studies over the past decade have described these needs, giving a gradually clearer picture of the stress points and barriers often experienced by learners in programs which ignore them.

Nearly a decade ago the Canadian Association for Adult Education (CAAE) cited twelve barriers frequently reported experienced by adults returning to formal institutional programs:

1. Financial problems.
2. Lack of coordination. ("Educational and referral agencies tend not to be aware of each others' activities and do not coordinate activities" [p. 11]).
3. Lack of support systems.
4. Lack of information.
5. Geographic barriers.
6. Institutional barriers. ("Institutions tend to offer courses rather than assess and respond to the various learning needs of adults" [p. 11]).
7. Fatigue.

8. Lack of time.

9. Attitudinal barriers. ("Adults who have negative or little experience in education feel uneasy about learning within institutions" [p. 12]).

10. Fees and other costs.

11. Scheduling. (Especially "inappropriate schedules and abrupt changes" [p. 12]).

12. Curriculum/learning needs. ("Adults with negative or little experience in education have different backgrounds from adults with substantial basic education, but they often find the curriculum organized with this latter group in mind" [p. 12]).

A 1990 survey of reluctant learners in British Columbia (Thomas, 1990) found similar barriers, concluding:

1. No single message or program delivery method will reach or suit all learners.

2. "Chaotic" lives require support from institutions.

3. Programs must be flexible in delivery, wide-ranging in content.

4. Bridges are needed between fulltime/parttime, formal/nonformal programs.

5. Peer counselling and support can be effective.

6. "Institutional and government workers must be sensitive to issues faced by low-literates."

7. Learning disabled need diagnostic and counselling help.

8. Low-literates are realistic: if jobs are scarce or require high levels of education, they will not be motivated.

9. Registration fees may help reduce "curiosity seekers." [This view is diametrically opposite to that of CAAE; see item one, above.]

10. Literacy programs are more attractive if they are self-paced, lack competition, promote social interaction, and are flexible.

A recently released aboriginal literacy action plan grouped its findings on barriers into four categories: situational, institutional, informational, and psycho-social (Saskatchewan Indian Institute of Technologies, 1991). Within these appear the factors already mentioned, plus:

1. Jurisdictional problems. [Situational barriers perhaps unique to aboriginal people dealing with various levels of government over treaty status and entailed rights to training and education.]
2. Physical disabilities.
3. Lack of culturally sensitive and appropriate curriculum materials.
4. Lack of appropriate role models.
5. Fear of discrimination, cultural conflicts.
6. Linguistic barriers.

Based on these barriers, the following is a list of the principal needs of adults which an ABE or literacy program should and <u>could</u> address with a well designed computer-assisted learning system:

1. Flexible scheduling.
2. Self-pacing.
3. Individualization.
4. Accessibility.
5. Privacy.
6. Lack of competition.
7. Learner choice.
8. Peer tutoring.
9. Small-group socialization.

The case for a competency-based curriculum

So far, this paper has dealt separately with technology and the adult needs of ABE and literacy learners. Where these come together -- that is, when it is time to design programs and produce or select learning materials for adult learners -- some guiding principles are needed. It is one thing to say that ABE and literacy programs should be self-paced, flexible, individualized and learner-directed; it is another to make them that way.

The competency-based model for learning means just that: the model focuses on what the learner is supposed to do as a result of his learning. The learner must perform at a level of accuracy and with the facility specified for the knowledge or skill involved. This performance is observed and rated. If the learner cannot (or will not) perform, no evidence of learning is assumed, and no rating can be given. (Marks are not awarded for intentions -- the teacher's or the learner's. Nor are marks deducted for attitude problems or other interference in the typical teacher-student relationship.)

The rationale for competency-based learning (CBL) is the mastery learning principle, which states that if time is varied in the learning process, the amount of resulting learning should be more standardized for a group of learners. In comparison, in traditional learning, where everyone takes a course of the same duration consisting of the same learning events, the amount of

time is standardized, and the amount of learning varies.

Norton (n.d.) describes five essential, and seven desirable, characteristics of competency-based programs. The essentials are:

1. Competencies to be achieved are carefully identified, verified, and made public in advance.

2. Criteria to be used in assessing achievement and the conditions under which achievement will be assessed are explicitly stated and made public in advance.

3. The instructional program provides for the individual development and evaluation of each of the competencies identified.

4. Assessment of competency takes the students' knowledge and attitudes into account but requires actual performance of the competency as the primary source of evidence.

5. Students progress through the instructional program their own rate by demonstrating the attainment of specific competencies.

Norton's desirable characteristics are as follows:

1. Instruction is individually-paced to the extent possible, rather than group-paced. (Norton adds, "While student progress is dependent upon the demonstration of competencies, this element does not mean that reasonable time limits cannot be imposed upon the students" [p. 3]).

2. Learning experiences are guided by frequent feedback. (Bloom [1987], in a very brief rebuttal of criticisms of the mastery learning model, was definite on this point, referring to the need for a "feedback-corrective" process involving both teacher assistance in the form of diagnosis, the presentation of alternative information and explanation, and further study and practice by the student working individually or with peers. After this feedback-corrective process, a second, parallel formative test is made available.

3. Emphasis is on helping the student achieve program exit requirements.

4. Instruction is based on the individual learner's needs

for learning time and practice, rather than on some external timeframe.

5. Instruction is, to a considerable extent, field-centred -- based on realistic work problems and situations.

6. Instruction is often modularized and uses materials with both required and optional learning activities to help achieve flexibility and provide for different learning styles.

7. The program as a whole is carefully planned and systematic, and evaluation data are used for program improvement. (p. 3)

Blank (1982) makes this point-by-point comparison of competency-based, individualized learning and traditional instruction, thereby summarizing the above succinctly.

Individualized	Traditional
1. Instructors focus on managing learning.	1. Instructors focus on managing instruction.
2. Students may enter at various times throughout the year.	2. Students enter at about the same time.
3. Different students may train for different occupations within the same program.	3. Students all cover the same material.
4. Students move on to the next skill only after mastering the skill they are currently working on.	4. Students all proceed from one topic to the next at the same time.
5. Students progress at their own pace.	5. Instructors control the learning pace.
6. Students are tested only when ready to demonstrate mastery.	6. All students are usually tested at once.
7. Immediate feedback is given to each student at critical points in the process.	7. Very little continuous feedback is given.
8. Retesting is encouraged for reaching mastery.	8. Retesting is discouraged or not allowed at all.

9. The program usually operates year around.	9. The program is usually closed down or shortened during the summer months.
10. Day and evening programs both have full access to resources.	10. The evening program is usually a restricted version of the day program.
11. Where possible, students determine the sequence of learning skills.	11. The instructor controls the sequence in which topics will be covered.

My thesis here is that the emphasis in CBL on student self-pacing and self-direction, and the role of the instructor as learning facilitator rather than source of information, produces a program which is more appropriate to adults at all functioning levels than what is described above as "traditional" learning. The problem with the school learning model is that it ascribes characteristics to all adult learners in a group (class) which are actually only those of the average. This results in schools and colleges dealing inefficiently with those either above or below the ascribed average in characteristics such as previous learning, speed or style of learning, motivation, even attendance).

The competency-based learning model remedies these inefficiencies of traditional adult education programs, while CAL makes delivery of efficient and effective competency-based learning programs possible.

Using competency-based learning principles in CAL

Foshay (1990) identifies three basic principles of the mastery learning model with direct implication for the design and management of adult learning:

1. Let learners begin instruction in a given topic only when they have fully mastered all prerequisites.

2. Let learners stay in instruction as long as they need to, to master the objectives.

3. Let learners progress to the next segment only when they have demonstrated mastery. (p. 3)

Foshay adds:

> Note that mastery-model instruction does not necessarily involve computers. It does involve considerable individualization, self-pacing, and frequent testing. These are possible, but difficult to do in classrooms. They are easy to do on computers. (p. 3)

As Foshay implies, computers are good at routine tasks and at keeping track of details. Both of these capabilities are useful in individualizing learning, where students will interact at their own pace with various learning materials, and where the results of this interaction must be documented and used to direct subsequent learning activities. In this model the uniquely human tasks of diagnosis, negotiation, motivation and planning/counselling are left to the instructor, who will have more time for them because the computer has taken over the routine jobs. Students experience a more receptive and flexible learning environment, containing far fewer barriers; instructors experience a focus of their role on dealing individually with

learners, helping them make choices from among the learning options available. Importantly, implementation of this competency-based learning process makes other elements of the learning process far less important: schedules, locations, times, attendance patterns, instructional resources, student-teacher interpersonal relations -- all are deemphasized. Actual learning, and the ability to use learning for real purposes, are emphasized.

Essential CAL features

Once the decision has been made to use CAL to achieve competency-based learning conditions in an adult program, other issues arise related to courseware, software, hardware, and support. The following is advice on what to look for in a CAL system in these areas.

Courseware

The actual instructional materials should, at the least, be useful to and usable by the adults in the program for which they are intended. That simple expectation has some interesting implications. First, there must be enough courseware on a broad enough range of topics to meet the expected needs and interests of the learners. (The desire to use literacy skills to learn something else is a powerful, some would say essential, motivator in any ABE program.) Learners should be able to find more than their ABE curriculum on the CAL system.

Second, the courseware must be adult in content and design.

The courseware should be clearly designed for adults, not "adapted" after-the-fact for the "adult market." This means, among other things, that lessons will be preceded by clearly stated objectives; that examples will refer to situations adults can identify with; graphics, sound and colour will illustrate, not entertain (adults have little patience with dancing octopi, fireworks displays, and whoopie-cushion sound effects, imported from the video games arcades; drill-and-practice and review options will be optional; lessons will have bookmarking (allowing the adult to leave when necessary and return to the lesson without having to start over); lessons and tests will not be time-limited; re-testing will not just be permitted, but encouraged; feedback will be clear and brief; review of lessons will be available; glossaries will accompany new terminology; and the design will be consistent over curricula.

Canadian content means more than an occasional reference to Hudson Bay, West Edmonton Mall, or Wayne Gretzky. At the minimum, a truly Canadian curriculum will adopt Canadian spelling conventions, place names, historical events, public figures, currency and postage, political institutions, public figures (there is a place for Wayne, after all!), maps and geography, the metric system (incredibly, some CAL systems marketed in Canada do not have this), and cultural events. It will also relate to Canadian testing standards and norms, and Canadian textbooks, references and other off-line supplements. Finally, the Canadian version of the courseware (if the vendor is multinational) will

be supported and developed in Canada.

The courseware will be designed, for the learning of discrete skills, on a competency-based model, assuring that (as Bloom recommended) students have the prerequisites before they begin study, and that they don't move on to new material until the exit requirements have been met. The courseware will permit retesting, to encourage pursuit of demonstrated mastery. Lesson activities will range from simple drill-and-practice to higher level application of skills. Suitable off-line materials will be available.

Finally, the courseware must be reliable and correct; it must not contain distracting errors or inconsistencies, or fatal execution errors (which make the computer freeze, or the program crash). Upgrades of the courseware (to repair errors and to assure increasing quality) should be regular, should be included in the courseware license price (to avoid budget headaches later), and must be easy for the user (you) to install. Installation should not result in loss of records for students presently working in the curricula. Problems and suggestions about the courseware should be sought out by the vendor, and there should be a regular procedure for submitting these.

Software

Software includes all programs on the system other than courseware, but especially the curriculum management system. The curriculum manager (CM) is the software which keeps track of things such as time, progress, curriculum choices, and testing

results when the CAL system is in use; allows the instructor to individualize the curriculum; organizes student data (and makes it available to other database systems); and generates various reports for the learner, instructor and manager of the system. The CM is the means by which the instructor can be there, when he or she isn't, and which assures the learner that the CAL isn't just a machine or a program.

As a basic capability, the CM should permit fine-tuning of the curriculum and learning conditions for each individual learner. This means permitting the instructor to rearrange (including omit) curriculum elements, add in materials from other sources and vendors, and, if required, author new materials.

Changing mastery levels, feedback messages and terms, and varying the types of choices the student faces are all done with the CM. Withdrawing records and generating reports is done with the CM. Evaluating group and individual performance by aggregating data is a CM function. The CM is crucial, but often under-valued, especially in the initial survey of system features. It shouldn't be.

Hardware

A CAL system should not require you to buy special hardware. If the system you acquire is proprietary (for one purpose only, and locked into that purpose -- and the vendor who supplies it) your use of it will be severely limited, probably to CAL only, and then only to the CAL system you initially acquired.

A well designed CAL system will run on a variety of

hardware, certainly on the industry standards. The vendor should give you the option of buying your hardware from some other source, and should assist you to shop around by providing clear specifications and prices. Once installed on equipment which meets specifications, the hardware system should be supported and warranted as if it had been purchased as a package from the courseware vendor.

Most, but not all, CAL applications will run on local area network (LAN) systems, based on a microcomputer fileserver. This simply means that the system will be less expensive than a mini-computer system, and will be relatively portable. At a minimum, then, the delivery system should be an industry-standard LAN, including one of the industry standard network typologies (Novell, ARCNET, Token Ring, Base Band, etc).

The LAN should be accessible by remote users, with remote telephone access. Multiplexer and modem access should both be available. (A multiplexer will allow multiple remote workstations to use one phone line, as long as the workstations are in the same location.) It should not be necessary to acquire a conditioned telephone line for this access to work reliably. (Conditioned lines are more costly than the voice-grade lines we all have in our homes and offices.) Again, remote access should have a proven record, and references, under the same conditions you intend to employ it. (Lots of things work well in the lab.)

Sometimes a LAN will be more than is required -- a standalone version of the curriculum will be needed. Your

prospective CAL vendor should have a standalone version of the curriculum, and a reliable medium for delivery (hard disk, or, increasingly commonly, CD-ROM). Full record keeping, including the option for uploading records to a LAN if desired, should be available for the standalone version. Again, a proven record of reliability, industry standards for the platform, and reasonable cost should obtain.

Needless to say, the CAL hardware system should be reliable and durable. For evidence of this, ask for references and talk to users who have had the system long enough to shake it down thoroughly. If the record isn't sound, be warned. At the very least, read the maintenance agreement extremely carefully.

Vendor support

The vendor of your prospective CAL system should provide both technical and educational support. Technical support should be close-by or, if distant, toll-free. (Many fixes and work-arounds which will solve a courseware problem require lengthy conversations with the technical folks; make sure this service is readily available, and that you aren't paying extra for this consultation.) Technical maintenance on your system should be reasonably priced (after the no-charge warranty period, which should accompany your new equipment, and which should be at least one year in length). On-site maintenance for the file-server is essential; the risks in packing and shipping the machine to a remote service depot are substantial. The supplier for the equipment should be Canadian, assuring service and eliminating

customs problems (delays and costs, to say nothing of the paperwork).

Educational support should be available from the vendor to help you accomplish your implementation plan, and to make introductions to the educational computing fraternity. The vendor should have on its staff credible adult educators, with qualifications and experience in adult education, available to you for this purpose. These are also the people who will be training you and your staff in use of the system, and who could be part of your evaluation steering committee, if appropriate. Look for a record of teaching and publishing, and evidence of esteem from peers in these folks.

The vendor should support user interaction by such vehicles as user group gatherings and newsletters, and should be a regular participant in conferences and seminars related to developments in adult learning. (A quick look in ERIC or Dissertation Abstracts will indicate how often the vendor's name is associated with current research, and who is doing the reporting.)

Finally, the best source of information about probable vendor support are customer references. Talk to present users of the vendor's products and ask them for their recommendations. Talk to a variety, and see their operations for yourself. Don't believe everything you hear or read -- see for yourself.

<u>To summarize: What to look for -- and avoid -- in CAL technology</u>

The technology of CAL is capable of providing for the needs

of adult learners and facilitating a new role for instructors. The degree to which any particular CAL system does so, however, is dependent upon the design philosophy and the learning assumptions of its creators.

The following checklist is intended to assist adult educators in evaluating CAL systems. The features evaluated here are those ABE learners have a right to expect from a well designed, adult learning system. The checklist includes courseware, software, hardware, and support.

CAL CHECKLIST

1. Courseware

_____ 1.1 Canadian content

_____ 1.2 Scope: core curricula consisting of literacy to GED (minimum)

_____ 1.3 Specialized topics outside core (i.e., keyboarding, computer applications, technology training)

_____ 1.4 Competency-based curriculum design: testing, tutorial, practice/application, posttesting

_____ 1.5 Off-line materials as complements, supplements or reinforcements to on-line materials

_____ 1.6 Adult graphics, style (appropriate use of animation, sound, colour)

_____ 1.7 Modularization

_____ 1.8 Proven reliability

_____ 1.9 Use of a variety of instructional strategies: tutorial, application, simulation, drill-and-practice, gaming, hypothesis-testing, etc.

2. Software

_____ 2.1 Student control of time (time tracked but not limited)

_____ 2.2 Student choice of topics, activities (testing, learning, review/application, records review)

_____ 2.3 Ability to use courseware from other vendors, sources

_____ 2.5 Ability to reorganize curriculum (omit, exempt, rearrange, augment, author)

_____ 2.6 Extensive data capture, reporting

_____ 2.7 Report generation (default and customized)

_____ 2.8 Data conversion for manipulation by other database software

_____ 2.9 Simplicity of use for students and instructors

_____ 2.10 Security

_____ 2.11 Bookmarking

_____ 2.12 Proven reliability.

3. Hardware

_____ 3.1 Industry standard platform

_____ 3.2 Proven reliability

_____ 3.3 Choice of stand-alone or local area network (LAN)

_____ 3.4 Remote access by dial-in (modem or multiplexer)

_____ 3.5 Local maintenance support

_____ 3.6 Capability of running other LAN applications simultaneous with CAL

_____ 3.7 Tape back-up capability

4. Support

_____ 4.1 Available, accessible technical support

_____ 4.2 Accessible advice, information (toll-free hot-line)

_____ 4.3 Educational expertise and experience to support program design, implementation and evaluation (beyond sales, technical)

_____ 4.4 Initial and ongoing training

_____ 4.5 Viable user group network

_____ 4.6 Newsletters, company-sponsored activities

_____ 4.7 Active, growing base of published research

_____ 4.8 Impartial product reviews, performance references

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